BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

As rescanning documents *will not* correct images, please do not report the images to the Image Problem Mailbox.

(12) UK Patent Application (19) GB (11) 2 192 696 (13) A

(43) Application published 20 Jan 1988

(21) Application No 8617233

(22) Date of filing 15 Jul 1986

(51) INT CL⁴
F42B 13/215 13/24

(52) Domestic classification (Edition J):
F3A 2C 2F 2L 2M
U1S 1201 F3A

(56) Documents cited
GB A 2147396 GB 1228204 GB 1143436

(58) Field of search
F3A
Selected US specifications from IPC sub-class F42B

(71) Applicant
Royal Ordnance plc

(Incorporated in United Kingdom)

Griffin House, P O Box 288, 5 The Strand, London WC2N 5BB

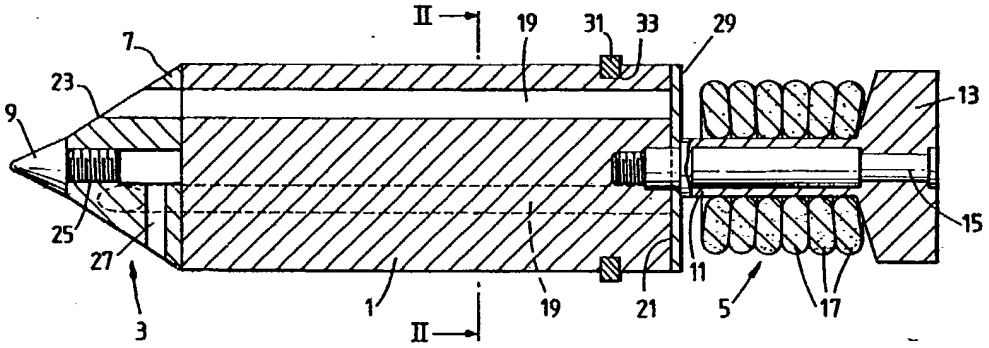
(72) Inventors
Alan Roy Weeden
John Nicholas Seabridge

(74) Agent and/or Address for Service
D J McCormack,
Patents & Licensing Department, Royal Ordnance plc, 2nd Floor, Griffin House, PO Box 288, The Strand, London WC2N 5BB

(54) Mortar projectile

(57) A mortar projectile comprising a body, a tail boom and a tail fin unit has one or more venting holes 19 extending through the body from the rear end toward the front end thereof, whereby to limit muzzle velocity and range, without sacrificing peak recoil force, when the projectile is used for bedding in a mortar or for training. In the latter case, one or more plates 29, of thickness chosen to burst at a predetermined pressure for unblocking holes 19, and an obturator ring 31 are provided. A nose 9 carrying an impact-detonated signature device with lateral vents 27 is screwed to the front end.

Fig.1.



GB 2 192 696 A

The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1982.

2192696

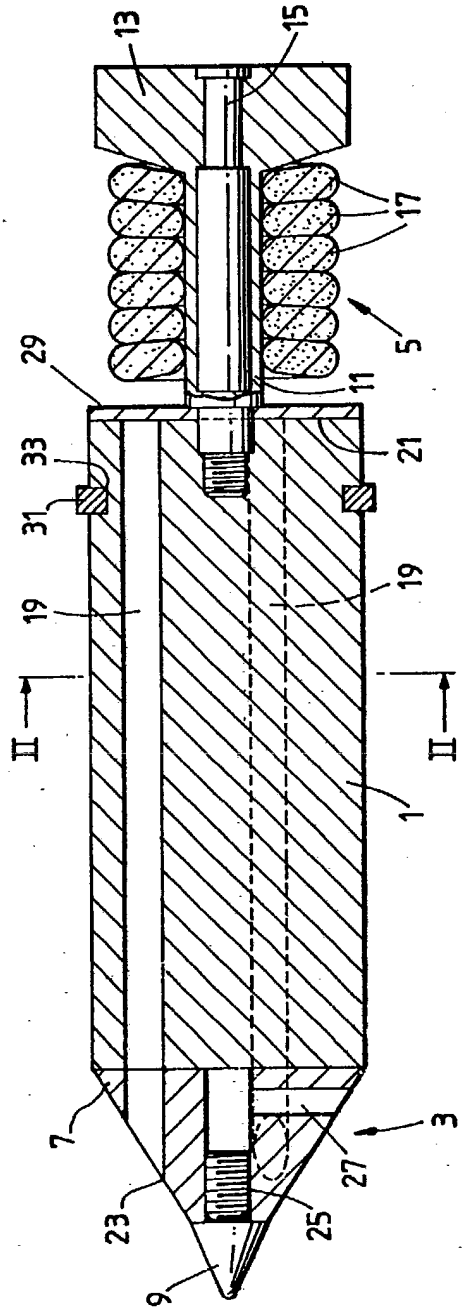


Fig.1.

Fig.2.

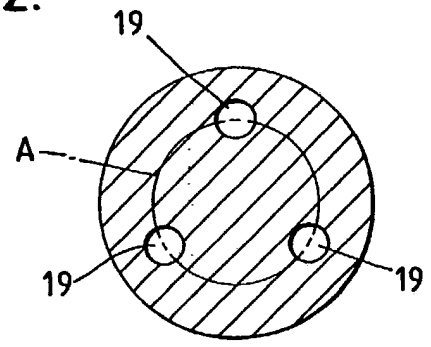
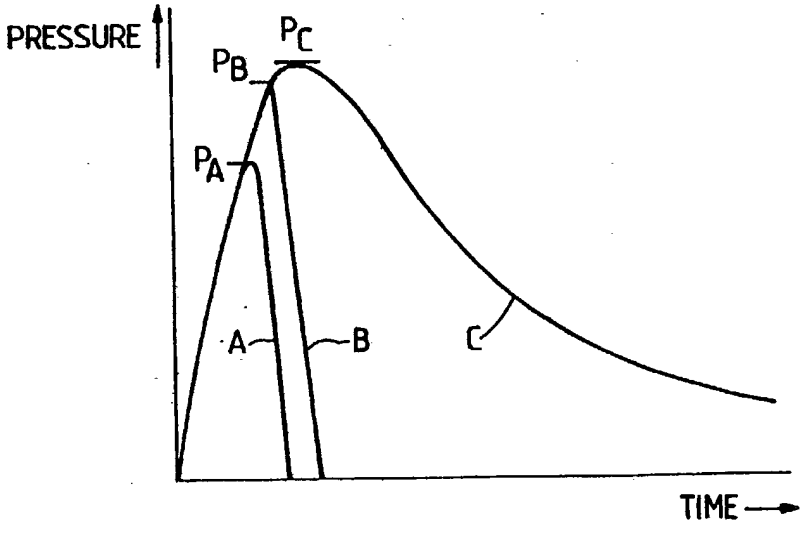


Fig.3.



SPECIFICATION

Mortar projectiles

The present invention relates to mortar projectiles.

In the operational use of a mortar, e.g. the British 81mm mortar manufactured by the present applicant company, the mortar has first to be bedded in the ground to stabilise the weapon and to absorb reactions produced when the weapon is fired. Conventionally, bedding in is provided by a base plate on the mortar which is anchored into the ground by the reaction obtained from initial firings of projectiles from the mortar. Traditionally, the projectiles used for this bedding-in operation are the live (e.g. high explosive) rounds required to be fired by the mortar. Such live rounds are expensive to produce and their use for bedding in can be hazardous to friendly crews. Also, it is difficult to monitor the bedding-in operation if the live projectiles are fired almost to full range.

According to the present invention a mortar projectile comprises a body, a tail boom and a tail fin unit at the rear end of the tail boom unit and is characterised by one or more venting holes extending through the body from the rear end toward the front end thereof.

The venting holes prevent the maximum pressure being attained within the mortar barrel and thereby limit the muzzle velocity and the range of the projectile as described below.

The projectile may consequently be used as a "bedding in" round. The projectile may carry a conventional charge system as used on a live round which provides a similar reaction on the mortar base plate to that produced by a live round, thereby allowing the base plate to be bedded into the ground without using a full range, live round.

Such a projectile allows bedding in to be achieved more cheaply and more safely than by using live rounds. The limit on the range allows the procedure to be more easily monitored.

According to an important feature of the invention one or more plates may be located on the tail boom behind the body to block the venting holes. The thickness of the plate or plates may be chosen so that the plate or plate construction bursts as a pre-determined pressure thereby unblocking the venting holes.

The projectile incorporating venting holes in its body and plate(s) located behind the body may then be used in a second operational mode as a training (practice) mortar ammunition round. The pressure at which the plate(s) burst may be chosen so that the distance travelled by the projectile is limited to a desired range which is greater than the range of the projectile used as a bedding in round (without the plate(s)) but not as great as the range of a live round carrying the same charge system.

Preferably, the body also carries an obturator ring when used as a training round.

Thus, the projectile of the present invention provides a dual-purpose mortar ammunition round whose use can be selected by the operator as appropriate. In the training round mode the range can be varied so as to match that required operationally by varying the number and/or thickness of the said plate(s) thereby adjusting the pressure v time characteristic of the mortar as explained below. The relationship between the number and thickness of plate(s) and range achieved may be obtained from a predetermined range calibration table.

The projectile according to the invention may include, e.g. in a nose at the front end of the body, a signature device for providing audible and visual signature when the projectile impacts the ground. Such devices are known per se in ammunition training rounds and may comprise a charge incorporating one or more compositions which provide a loud noise and/or smoke and/or a flash. Such devices may for example comprise a filling of gun powder and a coloured-smoke producing pellet which may be detonated by a conventional impact detonator. Such devices allow the user of the mortar to detect easily the place where the projectile falls to the ground thereby allowing the user to make any necessary adjustments to the mortar system based upon such detection.

In the projectile according to the present invention the body, tail boom and tail fin unit may be made of a strong, lightweight material, e.g. aluminium alloy. The body may comprise a cylinder in which a nose and the tail boom unit are fitted by screw thread joints at the front and rear ends respectively of the body.

The body may have a generally frustro-conical shaped front end into which the nose is fitted and a generally annular rear end surface, the venting holes extending from the rear end surface to the front end and emerging at the front end behind the nose. Preferably, the venting holes clear (i.e. do not join) the threaded aperture into which the nose is fitted.

One or more lateral venting holes may be provided extending between the threaded aperture into which the nose is fitted an the outside surface of the body to allow spent gases from the signature device to be suitably released. L For an 81mm mortar bedding in and training round embodying the present invention the projectile body may, for example, incorporate three or four venting holes equally spaced around an arc about the axis of the body. The holes may have for example a diameter of about 8 to 15 mm, e.g. 11 mm.

The shot kinetic energy (KE) of the projectile at the muzzle of a mortar is a function of the pressure v time curve produced within the

barrel by the charge system of the round. If either the maximum pressure or the duration of the pressure pulse is reduced then shot KE and hence muzzle velocity (MV) falls proportionately.

However, reducing the maximum pressure causes the recoil force to drop significantly. Additionally, for a given round, range is approximately proportional to KE. Therefore reducing the MV to achieve the very short ranges desired, either for "bedding-in" the mortar in combat or for training purposes would require unrepresentatively low peak pressures in the barrel giving very low recoil forces indeed.

The projectile according to the present invention has therefore been devised to reduce the duration of the pressure v time curve giving the previously unobtained combination of low MV and very high peak recoil force which is largely independent of propellant mass.

Embodiments of the present invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 is a cross-sectional side elevation (not to scale) of an 81mm mortar bedding in and training round embodying the present invention;

Figure 2 is a cross-sectional end elevation of the round shown in Figure 1 on the line II-II;

Figure 3 is a graph of pressure v time for 81mm mortar rounds.

In Figure 1 the round shown comprises a cylindrical aluminium body 1 having a front end 3 and a rear end 5. The front end 3 comprises a frustro-conical portion 7 at which the diameter of the body 1 tapers inward, the portion 7 having fitted therein by a screw thread joint 25 a nose 9 containing a conventional impact detonated signature device (not shown) containing a mixture of gunpowder and a coloured-smoke producing composition. The rear end 5 comprises a hollow aluminium tail boom 11 carrying a fin tail unit 13, a primary propellant charge cartridge being located in a cavity 15 inside the tail unit 13, and a series of crescent shaped augmenting charge cartridges 17 located on the boom 11.

Three vent holes 19 run along the inside of the body 1. The vent holes 19 are of equal diameter and are equidistantly spaced from the axis of the body 1 and (as shown in Figure 2) are equidistantly spaced circumferentially around the same arc A about the axis of the body 1.

The holes 19 extend from a rear surface 21 of the body facing the rear end 5 to a front surface 23 on the frustro-conical portion 7. The holes 19 clear (i.e. do not merge with) the cavity of the screw thread joint 25. Lateral holes 27 from the cavity of the screw thread joint 25 to the outer surface of the portion 7 allow gases produced following detonation of the device inside the nose 9 to be vented.

One or more aluminium annular shear discs 29 may optionally be located on the boom 11 behind the surface 21 and an obturator ring 31 fitting in a groove 33 may optionally be provided on the outside of the body 1.

For use as a bedding-in round the shear discs 29 and obturator ring 31 are preferably omitted. The performance of the projectile shown in Figures 1 and 2 when fired from a mortar is illustrated by curve A in Figure 3. This may be compared with curve C which is the pressure v time curve obtained with a live round. The pressure rapidly builds up inside the mortar barrel in both cases but at a maximum pressure of P_A, a high fraction, typically 70% of the maximum P_C obtained with the live round, the effect of venting of propellant gases through the holes 9 in the projectile shown in Figures 1 and 2 causes the pressure in curve C to fall rapidly. As a result the KE of the projectile, approximately proportional to the area under the curve, and the range of the projectile, approximately proportional to the KE, is thereby limited. Typically, the range is limited to about one third of that obtained with a live round as determined by curve C.

For use as a training round the shear discs 29 and obturator ring 31 are preferably included in the projectile shown in Figures 1 and 2. The performance of the projectile is illustrated by curve B in Figure 3. In this case the pressure rise follows curve C until a predetermined pressure P_B (greater than P_A, typically 90% of P_A) is reached when the discs 29 burst causing propellant gases to vent through the holes 9 thereby causing a more rapid fall in pressure than obtained with a live round as illustrated by curve B. As a result, the area under curve B and consequently the range of the projectile is greater than that when it is used as bedding-in round (curve A) but not as great as that of a live round (curve C). Typically, the range is one half of the range of a live round.

CLAIMS

1. A mortar projectile comprising a body, a tail boom and a tail fin unit at the rear end of the tail boom unit and is characterised by one or more venting holes extending through the body from the rear end toward the front end thereof.

2. A projectile as claimed in claim 1 and wherein one or more plates are located on the tail boom behind the body to block the venting holes, the thickness of the plate or plates having been chosen so that the plate or plate construction bursts as a pre-determined pressure thereby unblocking the venting holes.

3. A projectile as claimed in claim 1 or claim 2 and wherein the body also carries an obturator ring when used as a training round.

4. A projectile as claimed in any one preceding claim and which includes a signature

device for providing audible and visual signature when the projectile impacts the ground.

5. A projectile as claimed in any one preceding claims and wherein the body, tail boom and tail fin unit are made of a strong, lightweight material.

6. A projectile as claimed in any one or the preceding claims and wherein the body comprises a cylinder in which a nose and the tail boom unit are fitted by screw thread joints at the front and rear ends respectively of the body.

7. A projectile as claimed in any one of the preceding claims and wherein the body has a generally frustro-conical shaped front end into which the nose is fitted and a generally annular rear end surface, the venting holes extending from the rear end surface to the front end and emerging at the front end behind the nose.

8. A projectile as claimed in claim 7 and wherein the venting holes clear the threaded aperture into which the nose is fitted.

9. A projectile as claimed in any one of the preceding claims and wherein one or more lateral venting holes are provided extending between the threaded aperture into which the nose is fitted on the outside surface of the body to allow spent gases from the signature device to be suitably released.

10. A projectile as claimed in any one of the preceding claims and which is for an 81mm mortar bedding in and training round and incorporates three or four venting holes equally spaced around an arc about the axis of the body, the holes having a diameter of about 8 to 15mm.

11. A projectile as claimed in claim 1 and substantially as hereinbefore described with reference to the accompanying drawings.

Published 1988 at The Patent Office, State House, 66/71 High Holborn, London WC1R 4TP. Further copies may be obtained from The Patent Office, Sales Branch, St Mary Cray, Orpington, Kent BR5 3RD. Printed by Burgess & Son (Abingdon) Ltd. Con. 1/87.